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A GLACIAL ICE DAM AND A LIMIT TO THE ICE SHEET IN CENTRAL OHIO.

BY W. G. TIGHT.

The great continental glacier of the Plistocene will ever present many interesting problems to the student of those times. Its effects may be grouped under two heads; first, the general and widespread results of glacial action, and second, the local and minor effects produced by the action of local forces.

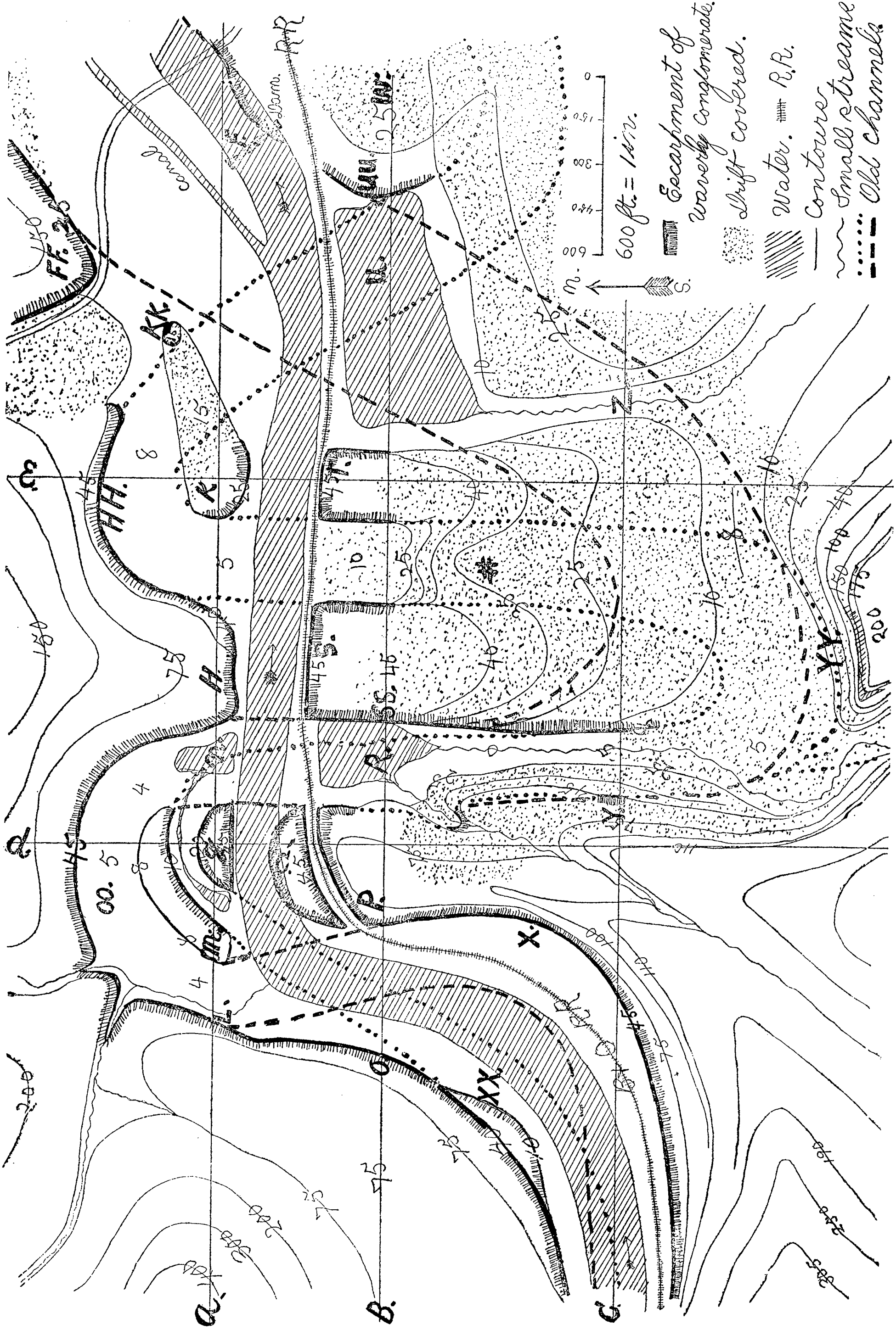
Believing that a careful study of these limited phenomena will help to illustrate some of the larger problems and enable us to gain a better understanding of the geological history of Plistocene times, the liberty is taken to present a few points of surface geology of a very limited region. It is hoped, however, that the accompanying map and sections will prove of interest.

Licking County lies near the center of Ohio, and is drained by the Licking River, which is formed at Newark by the confluence of three streams, The North and South Forks and Raccoon Creek. These streams form a hydrographic basin which is very nearly co-extensive with the county lines. The Raccoon Creek and North Fork rise in the western and northern portions, which are rather high lands; they flow through broad and open valleys, ranging from one-half to one mile in width, between the Waverly hills.

The valleys are filled with drift to a depth of 100 to 150 feet, increasing in depth toward their lower portions until at Newark the gas well borings show a valley filling of over 300 feet. These two streams are of rapid fall, ascending 250 to 350 feet in the 40 to 50 miles of their lengths.

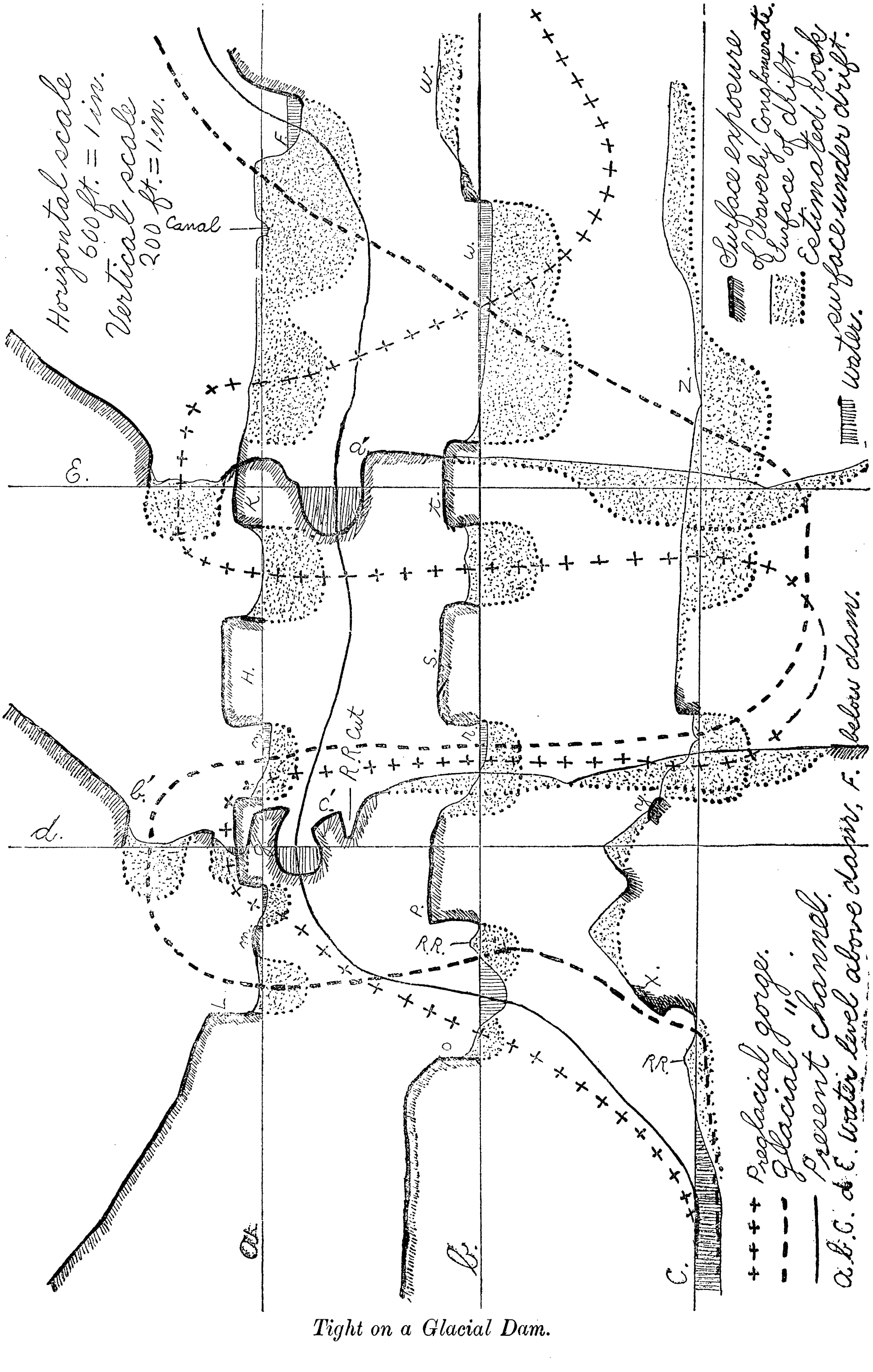
The South Fork rises on high ground in the south-western portion of the county, flows south and east to near the Licking Reservoir, which lies about 125 feet above Newark, from this point the watercourse is almost due north to Newark.

PLATE XIV.



Tight on a Glacial Dam.

PLATE XV.


Horizontal scale 600 ft. = 1 in.
Vertical scale 200 ft. = 1 in.
Canal
R.R. cut
RR.
A.
B.
C.
d.
E.
F
W.
w.
Z.
a'
b'
c'
H.
S.
P.
L
x
y
+ + + + Preglacial gorge.
– – – Glacial "
Present channel.
a. b. c. d. E. water level above dams, F. below dam.
Surface exposure of Waverly Conglomerate.
Surface of drift.
Estimated rock surface under drift.
water.

Tight on a Glacial Dam.

Along the east side of the North Fork, the hills rise rapidly to an elevation of about 250 to 300 feet, as they also do along the east side of the South Fork. Standing on these hills and looking west the country appears to gradually rise, but no very high hills are visible in this direction. A level, however, reveals the fact that the land to the west is nearly as high, but is so filled in with drift that only the tops of the hills appear above the general level.

In a few words, then, the conditions are these: waters flowing from the north, west and south, meet at near the center of the county and start due east, flowing a few miles over a broad flood plain, and then plunging directly into the hills of the eastern portion of the county and finally reach the Muskingum at Zanesville.

As the Licking River leaves the open plain it enters the hill country in a narrow gorge with perpendicular walls 50 to 100 feet high, and the hilltops, only a few hundred feet back on either side, rise 300 feet higher. This gorge is commonly known as the Licking Narrows, and is the subject of this sketch.

For about the first mile of this narrow cut there are two or three large curves, but the gorge is on an average about 500 feet wide, and confines the river in narrow limits. The Baltimore and Ohio Railroad makes many rock cuts in order to get along on the south side, and there is scarcely room for the towpath of the canal on the north side. The canal is in the river through this gorge.

The left-hand margin of the map, plate XIV, represents the river at the center of the last curve of this mile of gorge. The walls at X are 45 feet high and overhanging, showing a large amount of undercutting on the curve. The heavy shaded line represents the outcrop of the Waverly or Logan Conglomerate, and wherever exposed presents an escarpment with an elevation represented by the figures on the contour lines.[1]

The last curve of the gorge referred to above, extends to about O and P, at which point the curve of the next sigmoid begins. The gorge runs on past L m to the center of the next curve at OO, completing the curve at the point n.

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[1] All vertical measurements are from the water level in the river, which is constant on account of the dam below.

The river, however, does not follow this course, as will be seen by following the shaded portion which represents the present river course, but turns at a right angle and runs through a rock cut 150 feet wide, with overhanging walls at both g and c′.

Just south of c′ the railroad has made a rock cut 45 feet deep on a very sharp curve in order to get through the gorge. The rock g, known as Black Hand Rock, stands out with a bold front 45 feet high and 250 feet long next to the river, where the tow-path of the canal had to be blasted out. The rock slopes on its top toward the north, and presents an overhanging wall about 20 feet high on that side.

Within the large open area of the unoccupied curve north of g there is a low mass of rocks presenting the form indicated at m, with a vertical rock exposure 10 feet high on the south side of the mass and gradually falling off into the lower channel OO, which is only 4 to 5 feet above water level. At n, and between g and m, are ponds of water on a level with the water of the river. The channel, between g and m, is about 70 feet wide, while that between m and L is 200 feet also between g and the vertical cliff H, on the east side of the channel, is 290 feet.

Continuing the large curve L, OO, n southward to R, there is, on the east side, a long, straight bluff, SS, 45 feet high at the present river front, and gradually decreasing to about 8 feet at its southern end. On the high ground between X and this channel there is a light drift covering as indicated by the dotted portion. This drift covers the west wall of the channel except at Y, where the rock is exposed. At YY there is no escarpment, but the high hill presents a very distinct curve as is shown by the contour lines. Between Y, YY, Z and the double cross, there is a low drift plain with a form shown by the contours. The river does not follow this low gap which is nowhere over 15 feet above its present level, but has cut a channel through the rocky spur H and S, 300 feet wide and 45 feet deep to present water level. The river here has about 30 feet of water.

At K is a rock with 25 feet vertical front, and at T a rocky projection 45 feet high, through which the river has also cut, while there is an open channel 350 feet wide between K and HH, obstructed only by a gravel trail 15 feet high, extending from K to a low rocky exposure at KK.

The rocks S and T are also separated by a channel about 250 feet wide, presenting vertical walls for a short distance back from the river, and indicated farther south by a depression in the drift filling.

At FF is a high hill with a rock cliff 25 feet vertical. At u u there is a low rock wall which is extended to the dam at F. Wells in the drift terrace south of w show a buried channel there 50 to 75 feet deep.

By tracing out the curves and sigmoids indicated by these rocky walls, evidence is found for two distinct rock gorges, besides the one occupied by the present river, as shown by the heavy, dotted and broken lines respectively.

To make these data as clear as possible, five sections drawn to scales are presented in plate XV. These sections are taken along the lines bearing the same letters on the map and in the same position. The continuous, interrupted and crossed lines represent the courses of the rocky gorges, while the dotted portions represent the estimated depths of the drift-filled channels.

The interpretation of this peculiar locality is by no means certain. We venture an explanation which, in the light of Prof. I. C. Russel's investigations on existing glaciers, seems to me quite possible. There is abundant evidence for believing that the preglacial drainage of Licking County was to the south, and that a great morainic dam backed the water up until it broke over a col into the Muskingum basin.[2]

This col was at the point represented by C at the extreme left of plates XIV and XV. On each side of this low divide there was a ravine cut into the Waverly Conglomerate.

As the water rose over the divide and began to cut it down, the gorge produced by this cutting to the west of the point C conformed exactly to the pre-existing ravine running in that direction, as this ravine would represent continuously the lowest point in the divide, hence we find the upper part of the present gorge showing no marked changes in its position.

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[2] Full description of evidence for these conditions will be found in Bulletin of Scientific Laboratories of Denison University, Vol. VIII, Pt. 2.

The ravine on the down slope toward the east, however, whose outline is represented on plate XIV by the dotted line, and on plate XV by the crossed line, fared quite differently. A large volume of water suddenly attempted to occupy a small ravine. The result was that the first curvature was greatly increased and a great undercut made at X. Deflected from this point it struck the opposite or left bank of the ravine at m, and as it cut farther back into the great curve at OO, it also cut deeper and a small remnent of the left bank of the original ravine was left at m. The outline of this channel is represented by the broken line.

After making the curve at OO where considerable undercutting is also shown, the waters took a straight shoot south into the old ravine again.

At the south end at YY, the old ravine, as shown by the dotted lines, made another sharp curve similar to the one at g, and passed north between S and T to another curve at H H, thus making the next loop of the sigmoid which passed southeast through the point u.

Since the rush of glacial waters was not able to make the short turn at Y Y, and since the original surface level was lower than at H, they broke over the divide and made a new cross channel tending north-east in the direction Z u, and chocked up the old ravine between S and T with sediment. As the lower level was reached and the velocity checked, the lower courses of the intersected ravine were filled up with material cut from the gorge above. Evidence of these buried channels is found in many wells in the village of Toboso, just south of the river dam, which is across the present river at F.

There yet remains the great question, Why the river ever left this second channel which it had cut out at such a great depth and made a new one for itself straight across the rocky barriers at g c′, H S, and KT. If these were at the ends of the loops, or if the old channel was anywhere obstructed with drift, the explanation would be more simple. As it is, there seems to be but one solution to the problem to suggest, and we believe the facts point very strongly toward its support. This region is just on the eastern border of the Scioto lobe of the ice sheet. No glacial till is reported south or east of this point in Ohio. Does it not seem reasonable then that the great ice front or a local spur of it extended to this point and presented a front along a line represented by the north bank of the river in the line of L, m, g, n, H, K, and F, and remained there long enough for the river waters deflected at X to strike this ice barrier at L m, and, deflected along its front, to cut through the narrow and jointed rocky spurs at KT, then at HS, and last at g c′. If this is true, it will serve as a point in evidence of the probability of ice dams and a point to fix a limit to the ice sheet itself.

For fuller elaboration of the data of this region and other facts in evidence of the very near position of the ice front, see Bulletin of the Scientific Laboratories of Denison University, Vol. VIII, Pt. 2.